USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: REAL TIME CROP WATER MANAGEMENT AND IRRIGATION SCHEDULING WEB SITE

Proposal to: Kansas Water Resources Research Institute, KWRRI

Principal Investigators and Units:

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Project Category: Research/Educational/Extension

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Keywords: World Wide Web, Water Management, Crop Water Use

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Abstract

Increasing interest in irrigation scheduling and crop water management has occurred throughout Kansas. Traditional access to technical and educational information exists through workshops, seminars, field days, and published materials. However, busy schedules and other conflicts limit participation and access to these events. Access to and interest in the use of the World Wide Web has been growing at a fast pace. This project is designed to improve the transfer of water management knowledge and technology for improved agricultural crop production and resource conservation by using a Water Management Web Site housed within the Kansas Water Institute. Once the site is developed, established, and in use, other water resources related research results and extension information can be posted for additional technology transfer and enhanced knowledge of improved water management and crop production practices.

This Water Management Web Site will be designed to help the user with their irrigation scheduling and water management decisions. It will create crop water management accounts for individual users based upon input of their crop, soil, and geographic location. The Site will access the currently available real time weather data, estimate and log the crop water use, and display the results graphically for the user. The Site will update each water management account on a daily basis without requiring continual access by the user. This will enhance the use and availability of the automated weather data that must currently be accessed either daily or every three days in two of the Kansas Ground Water Management Districts. The individual will input rainfall and irrigation amounts to complete the water budget.

The proposed work will design, test/evaluate, display, and promote the Site throughout the course of the project. This Site will compliment the Virtual Water Office Site currently under development in another KWRRI funded project. Funding for long-term

maintenance is not available at this time. It is hoped that success of the Site will generate interest to provide the necessary support to continue to post and maintain the Site.

Technical Plan

Critical State Water Problem

The proposed work addresses State Water Plan Objectives:

3.1.5: By 2010, reduce the number of irrigation points of diversion for which the acre feet per acre (AF/A) water use exceeds the representative regional AF/A standard (1.0 AF/A in eastern Kansas, 1.5 AF/A in central Kansas, 2.0 AF/A in western Kansas) and those that overpump the amount authorized by their water rights.

3.1.6: By 2010, reduce the level of decline rates within the Ogallala Aquifer and implement enhanced water management in targeted areas.

3.1.12: By 2010, target data collection, research projects, and information sharing activities to address specific water resource issues as identified in the Kansas water planning process and to support and guide water resource program operations.

3.1.14: By 2010, provide educational activities to ensure that all Kansans have the knowledge necessary to understand the hydrologic cycle and to have an appreciation for demands and influences upon the state's water resources.

In 1996 a farmer initiated irrigation scheduling project was started in south central Kansas (the South Central Kansas Irrigation Management Project, SCKIMP). The South Central Kansas Irrigation Management Project is a cooperative effort between K-State Research and Extension and South Central Kansas irrigated crop farmers to transfer and promote the use of irrigation scheduling and water management technology. Thirteen center pivot irrigated field sites are used as irrigation technology transfer and demonstration sites. The irrigation system managers (field partners) are working with project personnel to learn how to access and use real-time weather data in their irrigation management program. That project was initiated with funds from the Kansas Center for Agricultural Resources and the Environment (KCARE) and the Water Protection Association of Central Kansas (Water PACK). The project is in its fourth year of a six year effort with current funding from the Kansas Water Office (KWO) and the Kansas Corn Commission.

During the past four years, the SCKIMP has conducted water management seminars during the winter, has conducted field tours at the partner sites during the summer, has met with the field partners throughout the production season, has created a Water News newsletter, and has established on-farm water management test plots on four of the field partner sites. Currently, over half of the field partners are calling the automated weather stations to retrieve the daily weather data. Planned efforts for 2000 will be to increase contacts with the field partners and to increase the computer use literacy with other farmers in south central Kansas.

Feedback from some of the field partners is that the need to access the weather station data on a daily basis and then to enter that information into a water budget or scheduling program is somewhat tedious and time consuming. This web site and/or downloadable programs would automate the process and make the data more readily available. Many farmers and crop consultants are aware of the information transfer power of an Internet based system and believe that they will eventually need access (several currently have Internet access or have tried to gain access); and there is an interest in computer/Web training. General training interests include hands-on activities that would include the

basics of particular types of programs, such as spreadsheets and word processing, use of specific existing software programs, such as irrigation scheduling, and general and specific applications of the Internet. The Water Management Web Site is designed to offer easy access to real-time data and cutting edge, easy-to-learn packages to assist them in optimizing water usage for conservation and crop yield. A further advantage is that no software is required to be installed on the users' machines beyond the standard Web browsers, and any updates to the software are instantly available with no effort required by the user.

Nature, Scope, and Objectives

The goal of this project is to develop, test, and display a user friendly Web Site that will provide a personal crop production account system with real time water management information and computer assisted decision tools for improved water use efficiency, crop management and planning, and increased economic returns.

Specific objectives are to:

- 1. Design and create a Water Management Web Site for farmers and crop production managers that will:

  1a. Develop and maintain a user specified account that will monitor within season water management and growth characteristics of corn for various geographic locations within Kansas, soil/field characteristics, and cultural practices; and

  1. 1b. Utilize automatic collection of real-time weather data (temperature, humidity, wind, solar radiation, and crop evapotranspiration) from K-State and/or Groundwater Management District (GMD) automated weather stations and provide customized delivery (compute crop ET, growing degree days, etc.) into the user specified account for water management, crop production, and forecasting purposes.

  307Performance testing and education. Workshops will be held to teach basic Web Site access and utilization to farmers and crop production managers (typically those who are SCKIMP partners and others that have cooperated with K-State). Web Site performance will be tested using real time crop production data from crop production sites within Kansas and the Site will be modified as needed.

- Display the Web Site for use by persons interested in crop water management with links to other pertinent crop production and water management information.

Related Information and Projects

Kansas currently has several automated weather station networks either through the groundwater management districts or through Kansas State University. These stations must be queried by the user either daily or every three days to obtain the reference evapotranspiration (ET) data. The reference ET data may be grass based or alfalfa based and must then be transformed with the proper crop coefficient to estimate the ET of the crop of interest. This can lead to errors and misuse of data which in turn can hinder acceptance of a very beneficial system for improved water management. The user must enter this data into their own software or water balance accounting system and they must maintain those records.

The South Central Kansas Irrigation Management Project has been working with thirteen center pivot irrigated farmers and/or system managers to perform these tasks for water management and irrigation scheduling purposes. A few have been calling the weather

stations on a routine basis, a few others have checked the weather data on a periodic basis, and others have not done anything.
Dr. Andresen, in conjunction with the Wind Erosion Research Unit at KSU, is developing a prototype PM10 (particles of pollution 10 microns or less in size) warning system with one to two day areal forecasts for high PM10 levels from wind erosion in the state of Kansas. Our prototype acquires weather data from the Web automatically. The prototype collects historical weather information from the pertinent weather stations and obtains forecast weather information from the NOAA Web site. It transfers this data via XML to a ``wrapper" application, which formats the generic weather information into a seamlessly merged set of input files for the erosion simulation, which then produces the pollution prediction. Historical weather data is from the KSU Automated Weather Stations network, consisting of 15 stations scattered across Kansas providing hourly information (uploaded daily to the central store). The automated sites provide temperature, wind, solar radiation, and ground temperature information.

The Water Management Web Site will also compliment the Kansas Water Resources Research Institute (KWRRI) funded Virtual Water Center Web Site Project currently in progress with B. Buddemeier (KGS), J. Koelliker (KSU), B. Hargrove (KSU), and G. Clark (KSU). The proposed Web Site will be housed within the server used for the Virtual Water Center, which offers close integration with the KWRRI Web resources and convenient collaboration on administration and maintenance.

Methods, Procedures, and Facilities:
Personal Water Balance Account:
The user develops an account for their crop by entering planting and/or emergence data, geographic location, and soil and field data. The crop may be irrigated or dryland. For irrigated crops, irrigation system data are entered. A water budget will be automatically maintained for each field by assessing water inflows (rainfall and/or irrigation events) and outflows (crop evapotranspiration and drainage) (see Figure 2). Rainfall and crop evapotranspiration data will be obtained through the automated weather station network or by links to other weather data Web pages. A chart depicting the estimated soil water profile will be updated daily and displayed (see Figure 3). The user does not need to access the account on a daily basis, it will be automatically maintained. The user can override inputs and correct soil moisture estimates or other automatically generated data with field or locally measured data.
Year 1:
Design and create the Web Site. A field/data input page will be developed for the user to input information on the planting date, hybrid maturity, soil characteristics, crop growth characteristics, and geographic location. Links and electronic access to the weather data base will be developed and built into the Site. Educational pages will be developed with links to the main input page. Separate educational pages will be developed to include information on Soils and Soil Properties; Crop Water Use (Evapotranspiration) and Crop Coefficients; The Fundamentals of Maintaining a Field Water Balance and Irrigation Scheduling; Corn Growth and Development; and Irrigation System Characteristics (Efficiency, Uniformity, Net Irrigation Requirements).
Year 2:

While, the first year will be used to develop a proof -of-concept implementation, linking the Site to the online weather systems and to develop an initial test of the various crop scenarios, the second year will be used to test, modify and validate the Site. The Site will have the ability to download relevant weather data for personal use. The Site will be tested in a real time mode by using field data and user feedback from locations within Kansas. Pages will be evaluated for their ease of use, consistency, and overall utility.

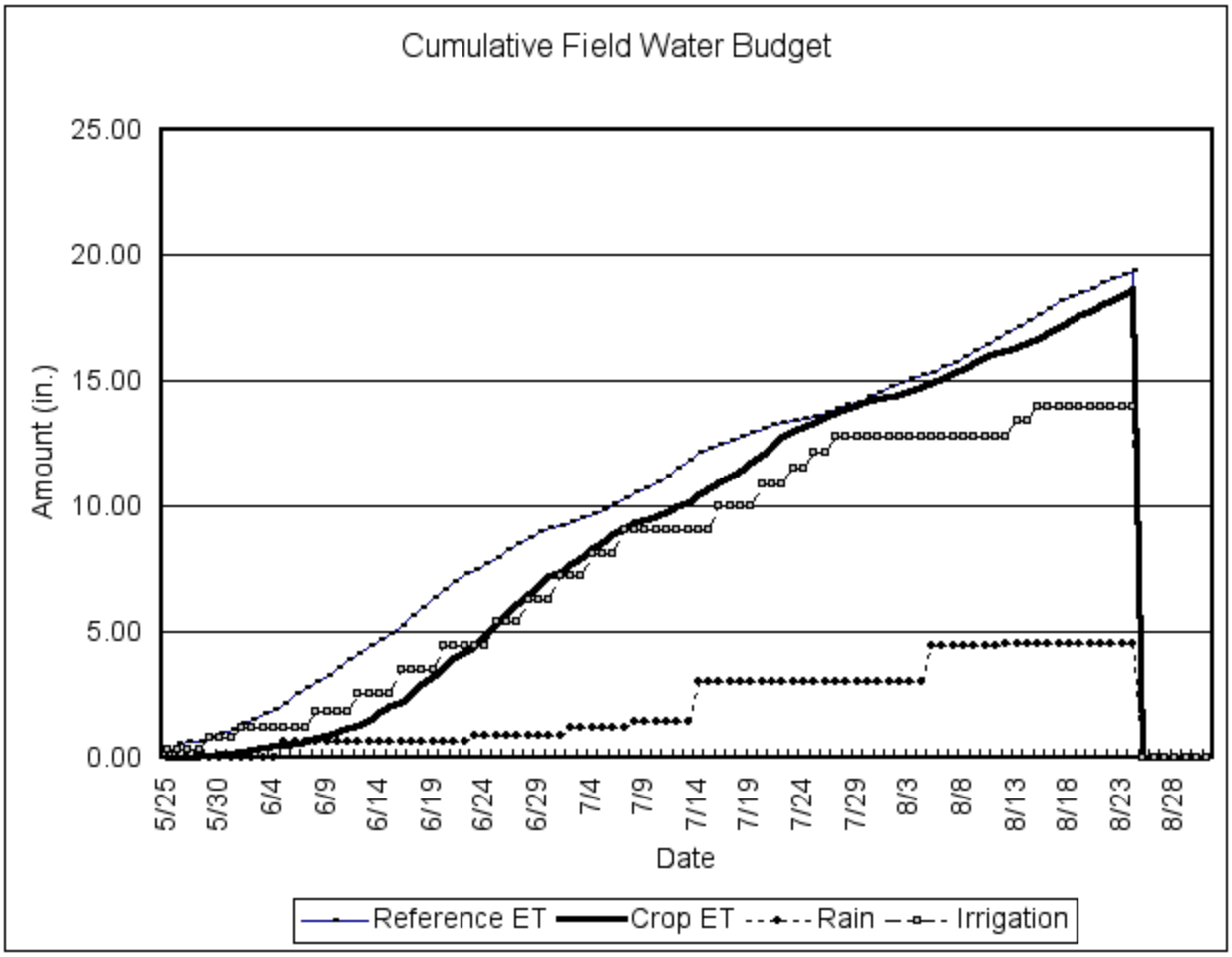

Figure 2

Figure 2: Cumulative field water budget showing water inflows (irrigation and rainfall) and outflow (estimated crop ET).

Figure 3. Field soil water contents showing field capacity (FC), management allowed deficit (MAD), permanent wilting point (PWP), the estimated field soil water content, and rainfall and irrigation events.

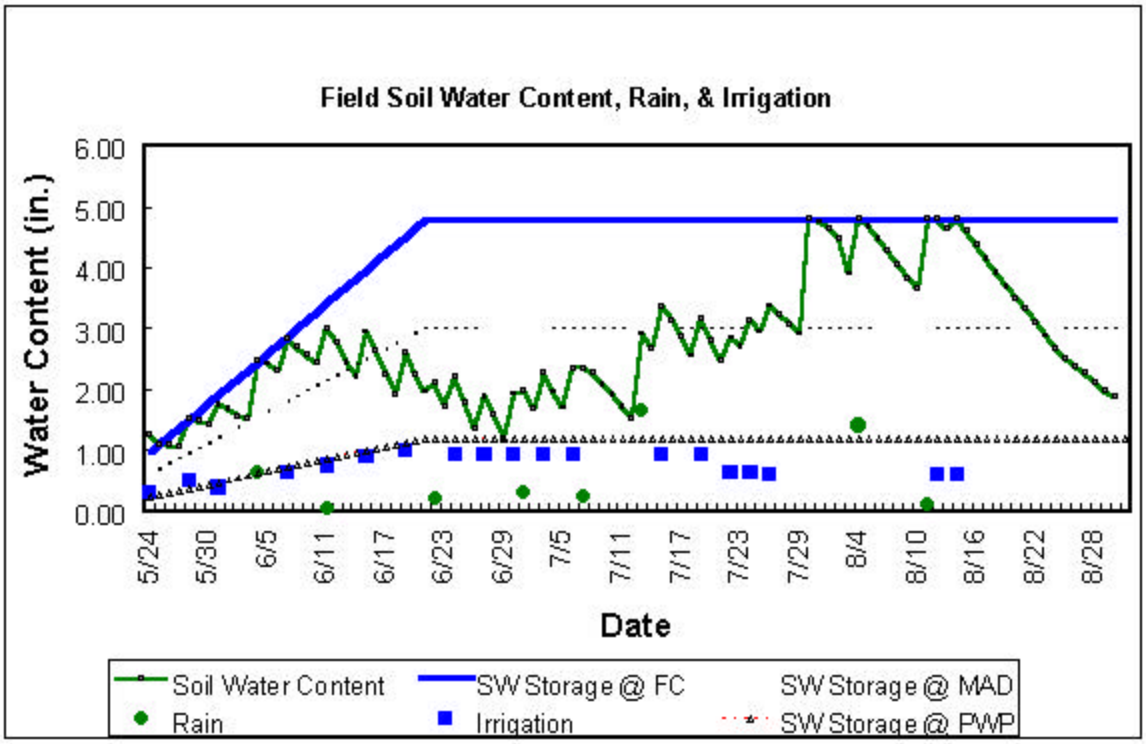

Figure 3. Field soil water contents showing field capacity (FC), management allowed deficit (MAD), permanent wilting point (PWP), the estimated field soil water content, and rainfall and irrigation events.

Technology and Information Transfer Plan

The Water Management Web Site will initially be located at the Department of Biological and Agricultural Engineering at Kansas State University. The site will be able to be accessed directly or through the KWRRI Virtual Water Center Site and the K-State Research and Extension home page. Workshops will be conducted in coordination with an existing water management project (The South Central Kansas Irrigation Management Project, SCKIMP) to provide training on how to access and use the Web Site. The SCKIMP activities will be conducted through the fall of 2001 and currently include a newsletter, and on-farm field days and educational workshops on irrigation management. Other existing K-State Research and Extension meetings, workshops and field days will be used to promote the Site. In addition to external instruction, the Web Site will have internal instructional pages to help individuals navigate through the Site. The Site will also contain water management information pages based upon existing Agronomy and Biological & Agricultural Engineering Research and Extension publications (crop residue management, soil characteristics, soil moisture sensors, irrigation scheduling, etc.). Results of this work will also be presented at regional and national scientific meetings and will be published in appropriate professional journals.

Expected Outcome and Benefits

This system allows users to learn about field water management at their own pace and on their schedules. It can benefit irrigated and dryland crop producers as well as turf and landscape managers. The field water budget accounts are automatically updated and do not require daily inputs or maintenance from the user. The user can query the system daily, weekly, etc. and can then assess their own water management program without loss of the real-time weather data from lack of calling the weather stations. The system will also automatically adjust for the reference ET base and crop system, thus minimizing a source of user error.

This should increase the use of and benefits from the existing weather station network that exists in Kansas. This in turn should improve on farm water management and result in greater levels of water conservation.

Other water management based materials and crop models could be included within or linked to the page. Materials may include general information on crop rotations or tillage practices. Crop growth models that predict yield may be included to allow users to plan future crop production management plans based upon water allocation for irrigated production or fall, winter, or spring soil moisture profiles for dryland production systems. These could be accessed during any time of the year and be used for educational and on-site management purposes.

This site can provide the initial basis for a tremendous amount of educational information to the Kansas crop growers. Many of these individuals are very busy and cannot make many of the physical location based educational meetings. Thus, such a site can be further developed to provide results of Kansas water management and crop production research to a very large audience.